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VIDEO TELEPHONE TERMINAL

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JP 1-265685
DE 2833541
DE 9002143

(57) Claim

1. A subscriber terminal for video telephone systems with a video display unit *including a display screen* having a display surface adapted to be inclined backwards, and a nearby video camera whose light path is directed towards a user, wherein only the pickup section of the video camera comprising a lens and an image converter is mounted separately from the camera's electronics immediately above a top edge on said *unit's* display screen, or immediately beside a side edge *of* said display screen, the camera's electronics being located behind the display screen.

P/00/011 28/5/91
Regulation 3.2

AUSTRALIA

Patents Act 1990

ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title:

"VIDEO TELEPHONE TERMINAL"

The following statement is a full description of this invention, including the best method of performing it known to us:-

The invention relates to a subscriber terminal for video telephone systems with a video display unit which is inclined backwards, and a nearby video camera whose light path is directed towards a user.

Such a subscriber terminal is known. This terminal has two housings connected by a joint, one of which forms the base on a desk and contains the circuits as well as operating controls, while in the other housing, which can be tilted upwards, a monitor and a camera are mounted. Folded together, both housings form a compact block-like device. If the upper housing is tilted up about the joint at the rear, a user looks at the monitor screen mounted on one side near the upper edge. The camera is mounted immediately beside this, but turned through 90° so as to save space, so that the light rays coming from the user must be deflected by a mirror placed before the lens. By altering the inclination of the upper housing, the terminal can be adjusted for persons of different heights.

Video telephones are also known, in which there is zero parallax between the camera and the video display unit, because their light paths are combined with respect to the user by means of mirrors. However, because the mirror which combines the light beams is semitransparent, optical errors and light losses must be accepted which naturally occur with this mirror, both for reflection and transmission. Furthermore, if large screen sizes are used, e.g. with screen diagonals of 14 inches or greater, the dimensions of the semitransparent mirror, which correspond approximately to those of the display screen, become large and the mirror becomes disproportionably expensive. Because of this, the terminal housings also become correspondingly large and awkward.

An object of the present invention is to provide a convenient compact subscriber terminal of the kind mentioned earlier for video telephone systems for which, on the one hand light losses due to semitransparent mirrors are avoided, and on the other hand eye contact between conversational partners is not affected by a disturbingly large parallax.

According to the invention, there is provided a subscriber terminal of the aforementioned kind wherein only the pickup section of the video camera consisting of the lens and the image converter, is mounted separately from the camera electronics immediately above the top display screen edge, or

immediately beside the side display screen edge, of the video display unit and that the camera electronics is located behind the display screen.

In order that the invention may be readily carried into effect, embodiments thereof will now be described in relation to the accompanying drawings, in which:

Figure 2 shows a side view of a subscriber terminal for video telephone systems, partly sectioned;

Figure 3 shows the front view and

Figure 4 shows the rear view of the embodiment according to Figure 2;

Figure 5 shows the side view of an embodiment with a rotatable housing section containing the display screen;

Figure 6 shows a side view of a subscriber terminal embodiment provided with further modules of communication technology;

Figure 6a shows the same view as in Figure 6, but before the attachment of an additional module consisting of handset and cradle

Figure 7 shows the front view and

Figure 8 shows the top view of the subscriber equipment according to Figure 6.

The subscriber terminal is labelled 1 in Figure 1. Since the shape of the housing is irrelevant to the description of the geometrical relationships, it is not shown. The video camera 11 and the video display unit 3 are shown schematically.

The eye-contact line 4 (eye-to-eye) between a user B and a conversation partner P on the display screen of the video display unit 3 is inclined at an angle g to the viewing line 5 to the lens of the video camera 11. The eye-contact line 4 is at an angle b to the horizontal line H. Also, the angle included between the optical axis 16 of the video camera 11 and the horizontal line H is labelled a. The line F represents the focus plane of the video camera 11 and its length corresponds to the picture size. The distance from the user B to the image plane of the video camera 11 is labelled with the letter a.

The preferred, ergonomically comfortable, viewing direction is inclined at $b = 10^\circ$ to the horizontal H. This is the direct line 4 between the eyes of the viewer B and the eyes of the displayed conversation partner P, and it thus

represents the "eye-contact" which is striven for and which must also be maintainable for long periods without fatigue. Such a downward viewing direction already occurs solely because of the fact that the image on the video display unit 3 generally represents a "reduced image of the partner". Therefore, from an ergonomic point of view, video telephones with particularly small video display units should be installed on a tripod or bracket so that the video camera is approximately at chin height.

With known parallax-free video telephones, the angle g between the lines 4 and 5, occasionally also referred to as the "error angle", achieves the desired value of 0° because, with exact compensation, the viewing angle can be made the same as the eye-contact line 4 by use of a semitransparent mirror. However, test results have shown that, even with an error angle of 8°, 85% of test observers still feel that they are being looked at.

It has been established that the best picture size is a portrait size with "extensive possibilities for personality representation". With this size, the video camera 11 takes the whole upper body with a single setting so that, in addition to facial expressions, gestures such as all kinds of hand and arm movement are also transmitted to the conversation partner P as desirable, non-verbal information. With a distance a = 115 cm, this picture size corresponds to a diagonal picture angle of approximately 35°, therefore approximately to a lens with a focal length f = 12 mm for the currently usual 1/2 inch CCD cameras. The eyes of an individual person then are positioned at about 3/4 of the picture height.

The subscriber terminal 1 is a desk model and can be pushed to the edge of a desktop, so that sufficient free working space is available in front of the equipment. Because of this, a suitable position is easily found in front of the equipment for the intended conversation, so that the partner P sees an advantageous picture, as the video camera 11 captures a scene of approximately 70 x 95 cm. With this large action space, a user B can not only arrange himself conveniently for the situation, but he can also clarify some things during the conversation with gestures. Even with moderate office lighting, with the camera setting itself to an aperture, for example, of 2.8, a depth of field of more than 45 cm is available.

The conveniently large picture range is not achieved by a strong wide-angle effect of the lens, but advantageously through a relatively distant "normal lens". The video camera 11 is aimed at the level of the mouth of the user B, approximately at the centre of the "portrait", at an angle a of 1° slightly below the horizontal line H, thereby avoiding the undesirable "frog perspective". A moderate zoom lens can be used with the video camera, so that the user B can occasionally change from a wide-space presentation to a targeted limited picture. With the available geometry, he can readily adjust to smaller picture angles (that is tele-effects), while variants with smaller picture angles (that is portrait lens) can be easily realised, as the geometrical limitations are then more favourable.

The camera position in the subscriber terminal 1 is chosen in such a way that the line 5 from the eyes to the lens practically coincides with the line 4, the "eye contact" line to the eyes of the conversation partner P. The exact divergence of both lines is at most an angular difference of g = 5.5°, so that the "mis-viewing" is not noticed by the partner in most cases.

If a 14-inch monitor is used as the video display unit 3, with the usual video standards for video telephones it should also have a distance of about 110 cm from the user so that the line structure is not visibly disturbing.

The subscriber terminal then provides a sufficiently large picture, so that the facial expressions and gestures of the partner are readily seen. Thus the illusion occurs that the partner has been reduced and is looking out of a 22 x 28 cm window at a distance of 110 cm. This corresponds approximately to a third of the angle at which the partners see each other when they are standing opposite each other.

If for another version a video camera 11 is used with a shorter focal length, e.g. f = 6 mm, then the distance a must be reduced to 85 cm which, for space reasons, can be necessary or an advantage. The angles of inclination for the lines 4 and 5 can be retained, namely b = 10° and g = 5.5°, i.e. the desired inclination of 10° remains for the eye-contact line 4 to the partner P on the display screen 3' of the video display unit 3. Since the above-mentioned lens of the video camera 11 has a significantly larger picture angle, the picture size height becomes 70 cm. The optical axis 16 can be inclined a little more than in

the earlier version, i.e. the angle a be increased to approximately 5° below the horizontal H in order to move the "portrait" properly into the picture.

In order to reduce the size of the subscriber terminal 1, a 5.7-inch monitor can, for example, be used in the video display unit 3. For the same video camera 11 as used in the previously mentioned version (f = 6 mm), and the same distance a of 85 cm, the same values result for the picture size. If the inclination of b = 10° is also retained for the eye-contact line 4, the parallax angle g can be reduced to 3°, since the video camera 11 can be positioned lower in view of the smaller monitor.

This subscriber terminal 1 can be moved towards the user B to a distance a = 55 cm. The picture size then still has a height of 45 cm, although the inclination of the video camera 11 must then be raised to 3° above the horizontal H in order to place the user B properly into the picture. However, picture distortion can not be avoided at such a small distance. Also, the angle of inclination b of the eye-contact line 4 with respect to the horizontal H increases to 18°, and that between the viewing line 5 to the lens of the video camera 11 and the horizontal increases to 13°. From this, a parallax g = 5° results, an error angle which is not perceived by the conversation partners as a departure from eye contact. Through the possibility of individually setting the inclination of the optical axis of the video camera 11, it is left to the user B to choose the distance a, and therefore also the distance to the picture, to suit his requirements.

In order to make the subscriber terminal 1 especially inexpensive, but still with good eye contact, a 10-inch display screen can be used for the video display unit 3, and a low-cost 1/3-inch video camera 11 with a focal length f = 8.5 mm. The distance a from the user B to the video camera can lie between 70 and 100 cm. The angle of inclination b between the eye-contact line 4 and the horizontal H is then approximately 18° to 10°, that of the viewing line 5 to the lens of the video camera 11 lies between 13° and 7°. Values of between 5° and 3° result for the parallax, which are well below the required value of 8°. The inclination of the optical axis 16 of the video camera 11 should be adjustable by a = ± 8° above and below the horizontal H.

The eye level of the user B is assumed in all cases to be 45 cm above the

desk surface on which the equipment stands, which corresponds to the average situation.

If a video telephone is conceived exclusively for a small picture size corresponding to a passport picture, that is the camera is equipped with a "normal lens" or a "short telephoto", then the small picture angles also permit a further reduction in the spacing of the components. Because of this, the dimensions can be made even smaller.

The following advantages are applicable for the camera and monitor, relative to the respective norms: with stronger light, the depth of field of the camera can be increased by the choice of smaller apertures, or the strength of the workspace lighting can be conveniently reduced. The influence of stray light is significantly less disturbing, the monitor picture has the best possible brightness, perhaps still further augmented by a customary contrast filter. If the camera is fitted with an integrated electronic CCD (charge coupled device) diaphragm, then the depth of field can still be set as desired with an additional, manually-operated "iris" diaphragm. Only with an extremely low light level does the diaphragm have to be opened more, either manually or remotely/automatically.

In Figures 2 to 4, reference 1 applies to a subscriber terminal for video telephone use or for a multimedia system. It consists of a housing 2 in which a video display unit 3 is provided with a display screen 3' and its outward-facing display surface 3". Its arrangement is so chosen that its optical axis 6 is inclined at an angle e of 5° to 30°, in particular approximately 20°, to the viewing direction or eye contact line 4 of a viewer or user B who is at a distance of approximately 50 to 70 cm, in particular of approximately 60 cm, from the midpoint M of the display surface 3". Thus the distance between the viewer B and the upper edge 9 of the display surface 3" and the display screen 3' is greater than the distance to the lower edge 10. The angle d between the optical axis 6 of the display screen 4 and the horizontal line H is approximately 10° to 40°, in particular about 30°.

Immediately above the upper edge 9 which forms the upper boundary of the display screen, the pickup section of a video camera 11 is provided, consisting of a lens 12 and an image converter 13, which is located wholly, or

at least partly, in front of the display surface 3". Together with the camera electronics 14 mounted behind the video display unit 3, this forms a video pickup unit. The pickup section of the video camera 11 and the camera electronics 14 are interconnected by a bus cable 15.

The video camera 11 is arranged inclined in such a way that, with a distance from the viewer B to the midpoint M of the screen of approximately 50 to 70 cm, in particular 60 cm, the optical axis 16 of the lens 12 lies at an angle f to the viewing direction 4 of the viewer B which is at most about 6°. When the viewer image taken by the video camera 11 is transmitted, this angle f is so small that it is not perceived as an error angle, and therefore not as a parallax error, by the partner at the other end of the communication path. In this connection it is advantageous if the video camera 11 is mounted centrally, that is on the vertical centre line 17 of the display screen 3', or near this line. In this way, a lateral error angle is, for all practical purposes, completely avoided and this contributes significantly to the perceived lack of parallax due to the vertical error angle f.

The video camera 11 can also be mounted beside the side edge 18 of the screen, preferably at the eye level of the partner or partner's image, generally in the upper third of the display surface 3". In this case a lateral error angle f' results of 8° at most, with a vertical error angle f = 0, or nearly 0. This arrangement also ensures that the partner does not perceive any parallax error.

Above the video camera 11, a fixed, adjustable or attachable roof-like hood 19 is provided, which is parallel to the optical axis 16 of the camera or slightly inclined to it, e.g. up to 10°. This can be continued to side screen sections 20, 21. The hood 19 and the screen sections 20, 21 can consist of a U-shaped surround which can also be a part of the housing 2. If an adjustable hood 19 is used, the design can be such that the slope and/or the projection of the hood 19 can be adjusted. The screen sections 20, 21 can possibly be capable of adjustment separately from the hood 19, or together with it.

Below the display screen 3', the housing 2 is provided with acoustic openings 23 on the front face 22. A loudspeaker 24 is provided behind these. It is useful for the loudspeaker 24 to be surrounded by a portion of the housing 25, open towards the acoustic openings 23, which forms an enclosed

loudspeaker box 26 within the housing 2 with a volume of 1 to 3 litres, in particular approximately 2 litres. By this means, acoustic requirements or interactions can be avoided between the loudspeaker 24 and other parts of the arrangement, or reduced to an insignificant level. The housing portion 25 can be a separate component, or it can be moulded onto the housing 2 when the latter is produced, and thus form an integral part of the housing 2.

In the region of the lower edge 27 of housing 2, at the rear face 28, a connector field 29 is provided with similar and/or different connectors 30.1, 30.2, 30.3. Connectors or a connector field can also be provided, possibly additionally, on one or both of the side walls 31, 32 and also on the front face 22 of the housing 2.

In the region of the lower edge 27, on the rear face 28 and/or on at least one side wall 31, 32, air-inlet openings 33 can be provided, and air-outlet openings 36 can be provided in the region of the upper edge 34 of the same surfaces, or on the top face 35 of the housing. Because of the chimney effect, cooling air can thus flow upwards along the video display unit 3 and the camera electronics 14, and provide for their cooling.

Above the upper screen edge 9 an acoustic opening 37 is provided in the housing wall, in the front face 22 or in a surround forming part of it, and a microphone 38 is provided behind this opening. In order to achieve the lowest possible coupling between the loudspeaker 24 and microphone 38, especially for hands-free speech, these two parts are preferably mounted diagonally to each other, with as large a separation as possible, and mechanically decoupled, e.g. separated by a dividing partition or by absorbing material. The microphone diaphragm is oriented towards the user B. Preferably it is, or can be, mounted at the level of the viewer's mouth.

The subscriber terminal 1 can be implemented in two parts, as shown in Figure 5. For this, an upper housing section 39, containing the display screen 3' and the video camera 11 and possibly the camera electronics 14, is movably attached to a lower housing section 40. For this purpose, a hinge 41 or a suitable joint is provided, so that the angle of inclination d of the optical axis 6 of the display screen 3' to the horizontal H is adjustable. The connection can be chosen in such a way that the upper housing section 39 can be rotated into a

horizontal position, shown with dashed lines in Figure 5, e.g. for transport or for a rest position, etc.

In accordance with a preferred embodiment of the invention as shown in Figures 6 to 8, a first module 47 of the subscriber terminal 1 containing the display screen 3', the video camera 11, the loudspeaker 24, the microphone 38 and the camera electronics 14 can have fastening means or connectors which are provided at least on one side, that is on the front face 22 and/or on the rear face 28 and/or on at least one side wall 31, 32 and which operate together with corresponding fastening means on a second module 48.

In Figure 6a the two modules 47 and 48 are shown separately. The second module 48, for example, comprises electrical and/or mechanical devices which are, or can be, associated with the first module 47 and possibly such devices which can also function separately. The second module can, for example, comprise a handset cradle 42 with handset 43, a dialling keyboard 44, a function keyboard, a power supply 45, a cooling fan, etc., as well as supplementary telecommunication equipment. The modules are so designed that the second module 48 can be exchanged with another similar, identical or different second module 48. Therefore, in a simple way, subscriber terminals 1 can be assembled with identical or different features, where the housing dimensions are adapted to the requirements and thus optimally compact functional units can be produced, or existing ones re-arranged in a simple way.

Finally, a receiver 46 for acoustic and/or electromagnetic waves can be provided at the front face 22, or on it or behind it. The receiver 46 can be influenced from a remote control transmitter, so that with it adjustments can be made on the subscriber terminal 1 or on supplementary associated devices.

In accordance with another preferred embodiment of the invention, the lens 12 or the video camera 11 is provided with means for adjusting the focus, e.g. an adjusting lever or adjusting ring, which can be manually reset from the front face 22. If the lens 12 does not project, or does not project far, beyond the front face 22 or the display surface 3", then at least one, e.g. conical, recess 49 is provided in the housing wall, as shown in Figure 7, in which the focussing means are located and where they can be operated with the fingers. In Figure 7 two recesses 49 are formed by an oval-shaped cone.

By means of the invention, a compact subscriber terminal can be implemented which, apart from a non-noticeable parallax error, offers a number of possibilities which are especially likely to find applications in multimedia systems.

The claims defining the invention are as follows:

1. A subscriber terminal for video telephone systems with a video display unit ***including a display screen*** having a display surface adapted to be inclined backwards, and a nearby video camera whose light path is directed towards a user, wherein only the pickup section of the video camera comprising a lens and an image converter is mounted separately from the camera's electronics immediately above a top edge on said ***unit's*** display screen, or immediately beside a side edge ***of*** said display screen, the camera's electronics being located behind the display screen.

2. A subscriber terminal as claimed in claim 1, wherein the display surface of the display screen is horizontally inclined in such a way that the distance between a user and the upper edge of the display surface is larger than the distance to the lower edge of said display unit, the angle between the viewing direction of the user and the display screen's optical axis being 5° to 30°, the pickup section of the video camera being arranged outside the boundary of the display screen in such a way that, at a viewing distance of approximately 50 to 70 cm, the angle between the optical axis of the lens and the viewing direction is an angle of 6° maximum with the arrangement at the upper display screen edge , or an angle of 8° maximum with the arrangement beside the side display screen edge .

3. A subscriber terminal as claimed in Claim 2, wherein a roof-like hood is provided above the pickup section of the video camera the inclination and/or projection of said hood being adjustable.

4. A subscriber terminal as claimed in Claim 2, said display screen is mounted in a housing and wherein on the front face underneath the said display screen, said housing is provided with at least one acoustic opening behind which a loudspeaker is mounted, in said housing in the region of the loudspeaker, a portion of the housing is moulded-on or can be attached, which is open to said acoustic opening and forms a closed loudspeaker enclosure with respect to the housing , at least one acoustic opening being provided in the housing wall above the display screen for mounting a microphone, the open portion being arranged diagonally to the acoustic opening, and mechanically decoupled therefrom .

5. A subscriber terminal as claimed in Claim 4, wherein between an upper

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housing section which contains said display screen , and a lower section which contains the loudspeaker , at least one hinge or joint is provided the upper housing section being adjustable in relation to said lower section in such a way that the angle of inclination between the display screen's optical axis and the horizontal is variable, and/or the upper housing section and the lower housing section can be folded together.

6. A subscriber terminal as claimed in Claim 5, comprising two modules which are connected, or can be connected, electrically and mechanically by fasteners and/or connectors, the first module comprising of at least the display screen , the video camera , camera electronics , loudspeaker , microphone , and receiver for remote control of the subscriber terminal , and the second module comprising devices for telecommunication which are associated with the first module but are also capable of functioning separately.

7. A subscriber terminal for video telephone systems with a video display unit including a display screen, which is inclined backwards, and a nearby video camera whose light path is directed towards a user, wherein the video camera is mounted immediately above the display screen and has a portrait lens with a focal length f = 12 mm and said display screen,being 14 inches at a distance of 115 cm from a user to the video camera , the angle between the horizontal and the eye-contact line of said user to a remote party imaged on the display screen is about 10°, the angle between this eye-contact line and the viewing direction to the video camera being approximately 5.5°, and the optical axis of the latter can be adjusted over an angle of inclination of ± 5° above and below the horizontal .

8. A subscriber terminal for video telephone systems with a video display unit including a display screen, which is inclined backwards, and a nearby video camera whose light path is directed towards a user, wherein the video camera is located immediately above the display screen and has a wide-angle lens with a focal length f = 6 mm and the display screen being a 14 inch display screen, and wherein at a distance of 85 cm from the user to the video camera , the angle between the horizontal and the eye-contact line of said user to a remote party imaged on the display screen is about 10 °, the angle between this eye-contact line and the viewing direction to the video camera

being approximately 5.5°, the optical axis of the latter being adjustable over an angle of inclination of 0° to 10° below the horizontal .

9. A subscriber terminal for video telephone systems with a video display unit including a display screen, which is inclined backwards, and a nearby video camera whose light path is directed towards a user, wherein the video camera is located immediately above the display screen and has a wide-angle lens with a focal length f = 6 mm and the display screen being a 5.7 inch display screen, and wherein at a distance of 55 to 85 cm from the user to the video camera , the angle between the horizontal and the eye-contact line of said user to a remote party on the display screen is 18° to 10°, the angle between this eye-contact line and the viewing direction to the video camera being 5° to 3°, and the optical axis of the latter being adjustable over an angle of inclination of ±5° above and below the horizontal .

10. A subscriber terminal for video telephone systems with a video display unit including a display screen, which is inclined backwards, and a nearby video camera whose light path is directed towards a user, wherein the video camera is located immediately above the display screen and has a normal lens with a focal length f = 8.5 mm and the display screen has a 10 inch display screen, wherein at a distance of 70 to 100 cm from a user to the video camera , the angle between the horizontal and the eye-contact line of said user to a remote party imaged on the display screen is 18° to 10°, the angle between this eye-contact line and the viewing direction to the video camera being 5° to 3°, and the optical axis of the latter being adjustable over an angle of inclination of ±8° above and below the horizontal .

11. A subscriber terminal substantially as herein described with reference to Figures 1-8 of the accompanying drawings.

DATED THIS ELEVENTH DAY OF OCTOBER 1993

ALCATEL N.V

ABSTRACT

A subscriber terminal (1) for a video telephone and multimedia systems and which, by avoiding mirrors, permits a very compact construction and nevertheless provides freedom from parallax for the remote viewer, despite the presence of an error angle. The subscriber terminal (1) can be combined with other modules (48).

Several versions are suggested for the subscriber terminal (1) which, by using different display screen sizes in the video display unit (3), and lenses with different focal lengths in the video camera (11), allow the parallax to be kept to less than 6° between the viewing line (5) to the video camera (11) and the eye-contact line (4) to the conversation partner (P) on the display screen (3')
(Figure 1)

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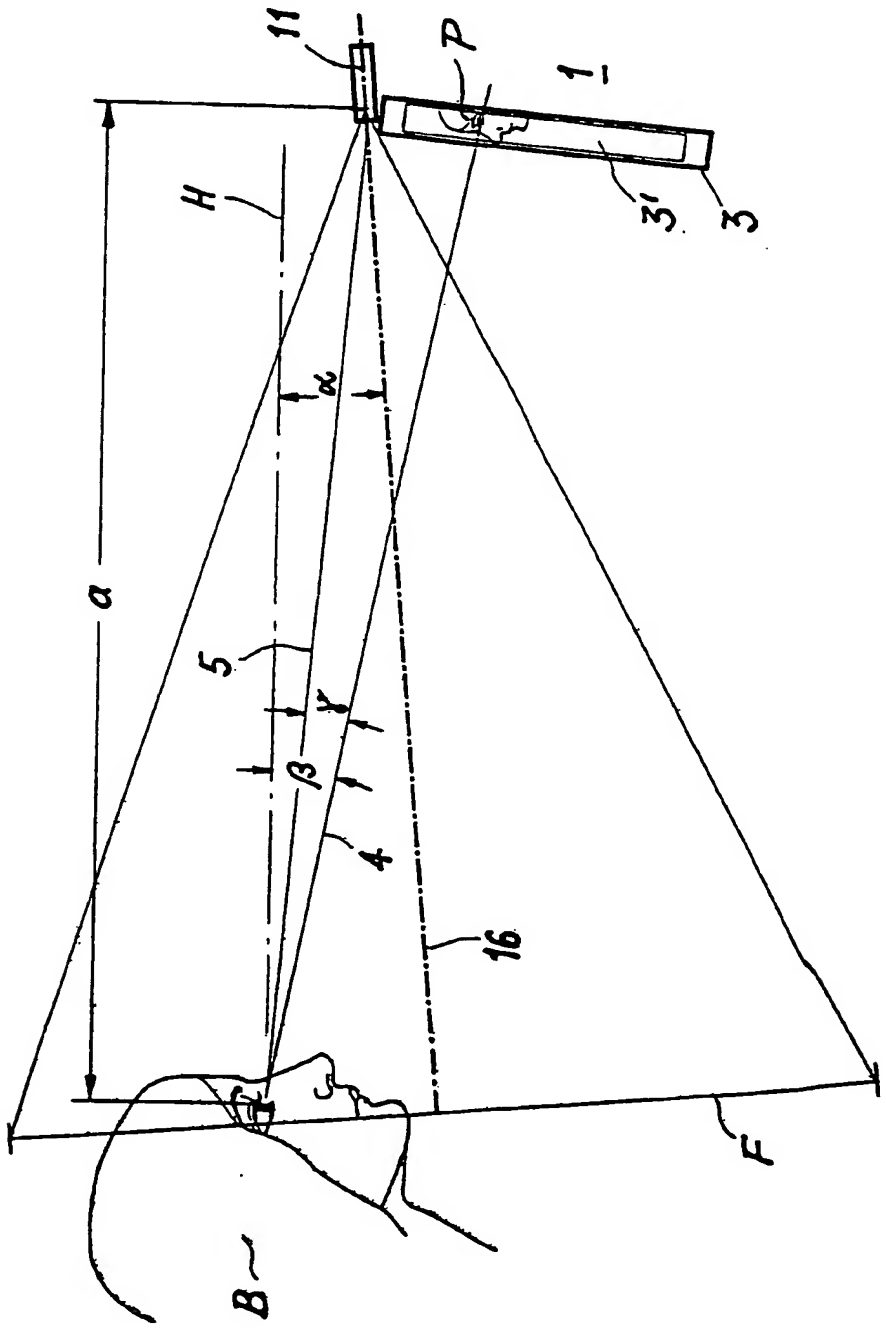

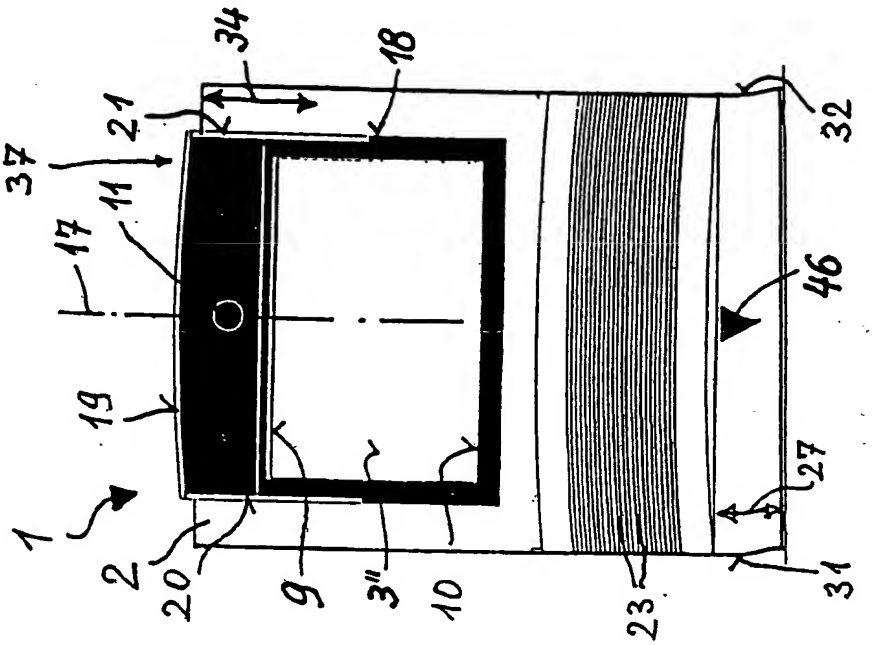
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Fig. 3

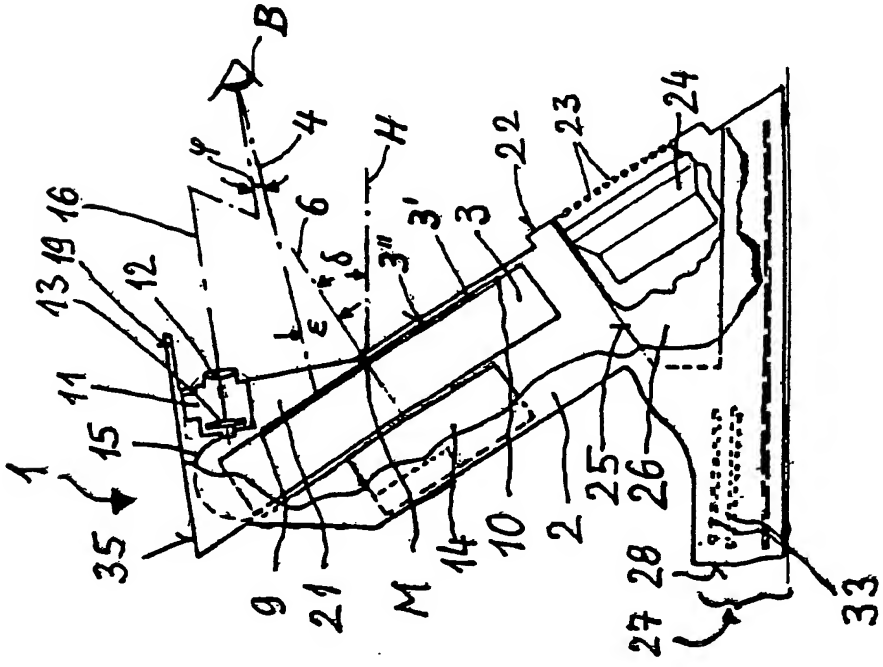
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Fig. 2

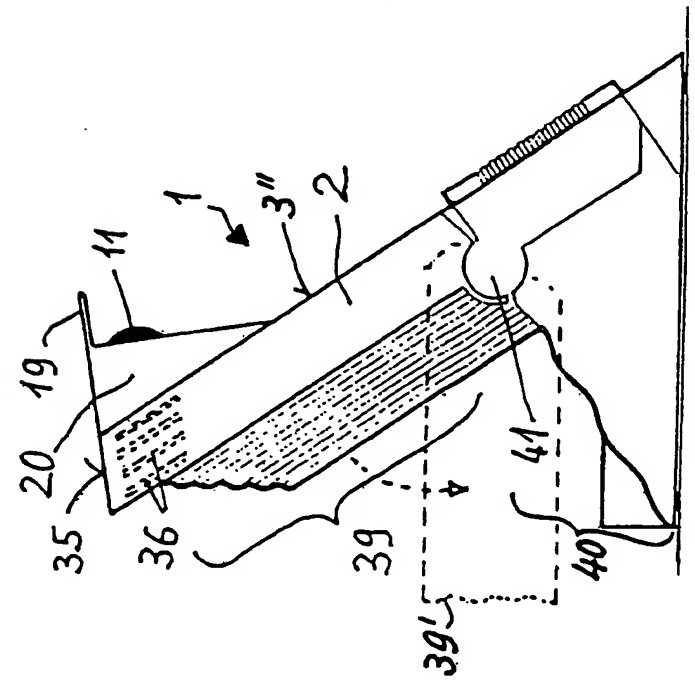
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Fig. 5

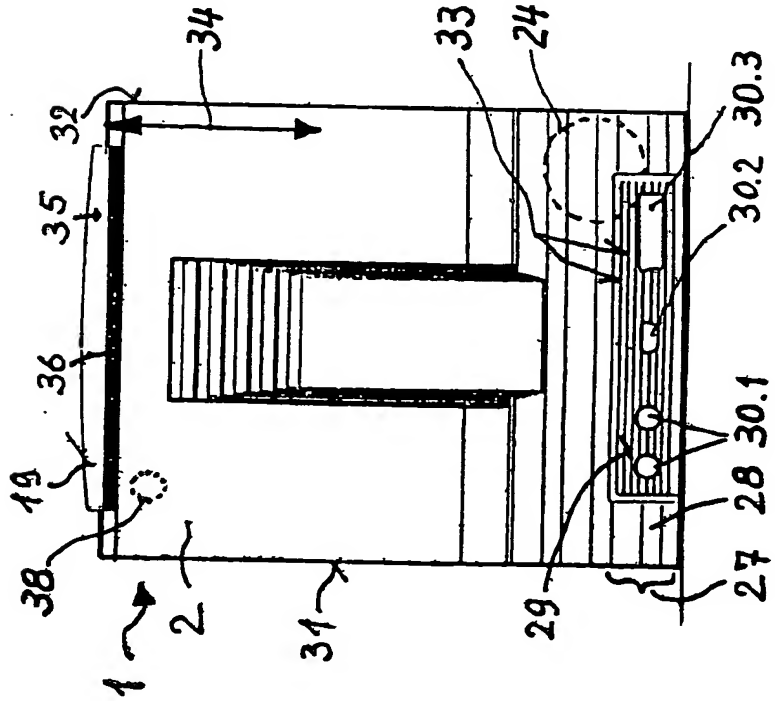
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Fig. 4

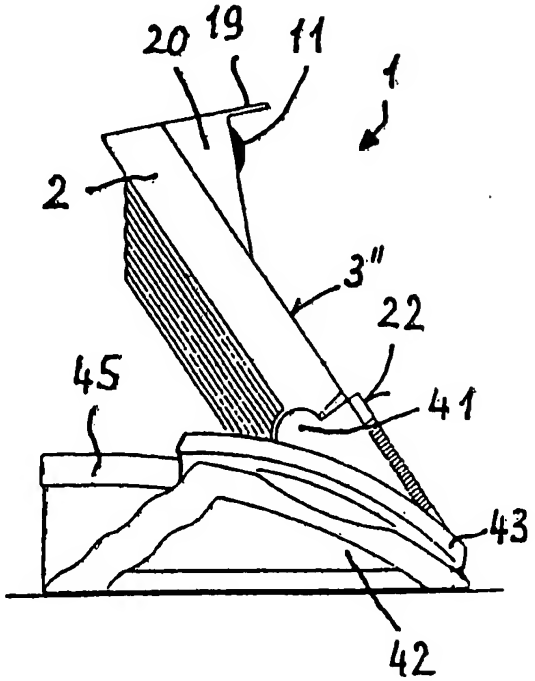

Fig. 6

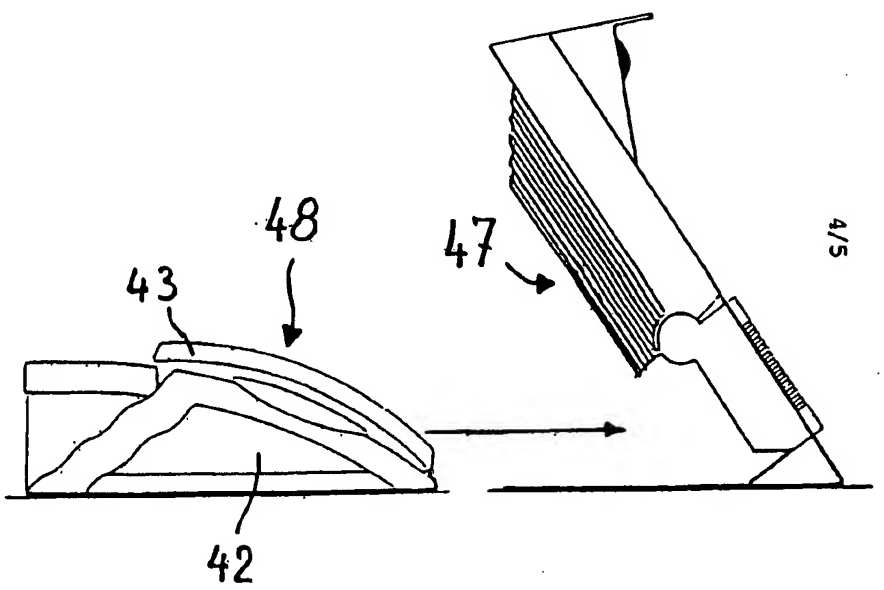

Fig. 6a

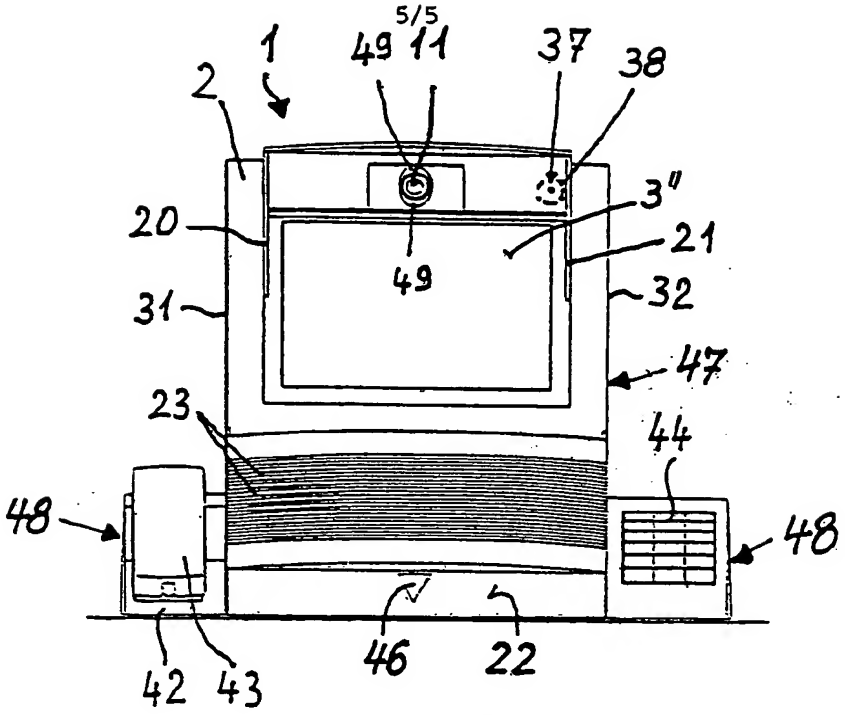
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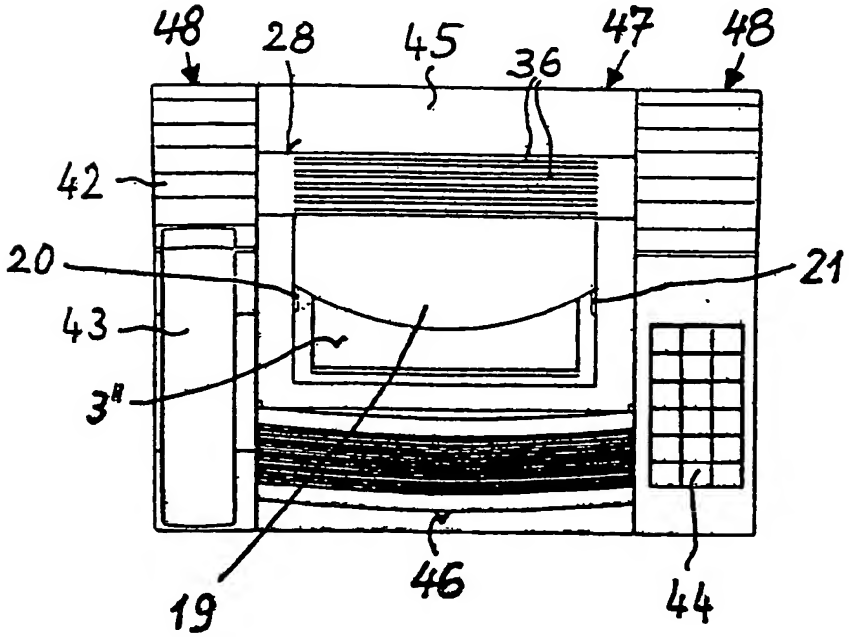
Fig. 7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47
48
42
20
21
43
3"
46
44
19

Fig. 8